

ITER Plasma Facing Components

Potential US Role

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Outline

- Divertor design for the new ITER
- Port Limiter design
- Shield/First Wall design
- Preliminary assignment of US contribution
- ITER interest in PMI research on near term
- The balance between ITER and long term PFC development



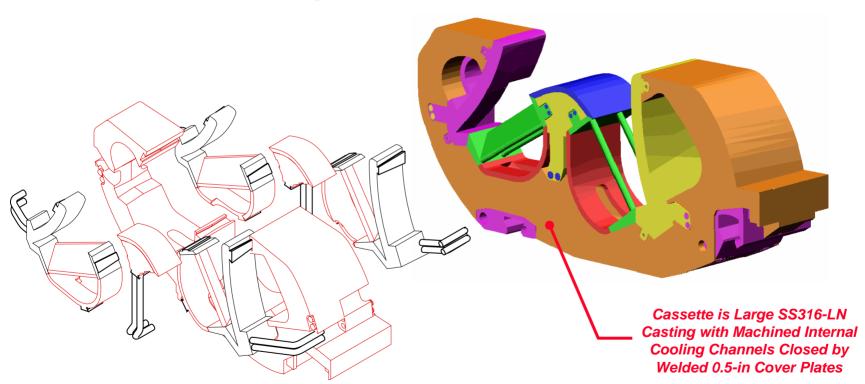
Divertor design for the new ITER

- Changes since the EDA
 - The wings have been eliminated
 - The area under the dome has been made very transparent to neutrals
 - Louvers between the dome passage and the pump duct are thermally isolated to minimize C/T deposition
 - The cassette body is much thinner
 - Cassette to cassette electrical connectors are eliminated.



ITER-97 Divertor Cassette Assembly

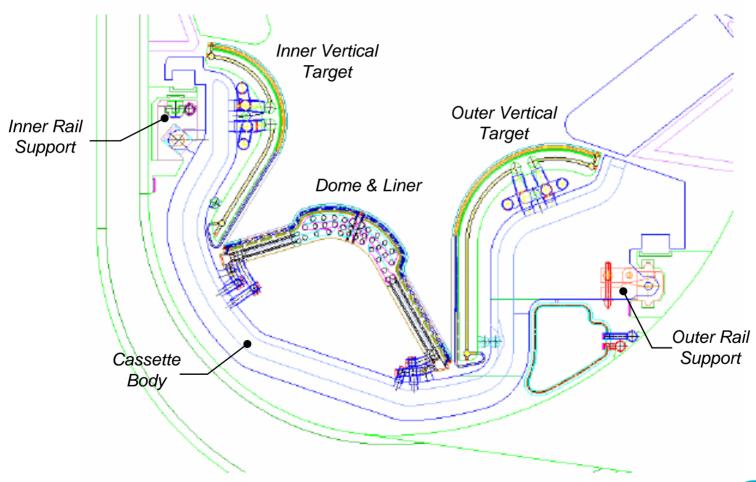
25-Ton Assembly Including Half-width Plasma Facing Components





Divertor Components and Nomenclature

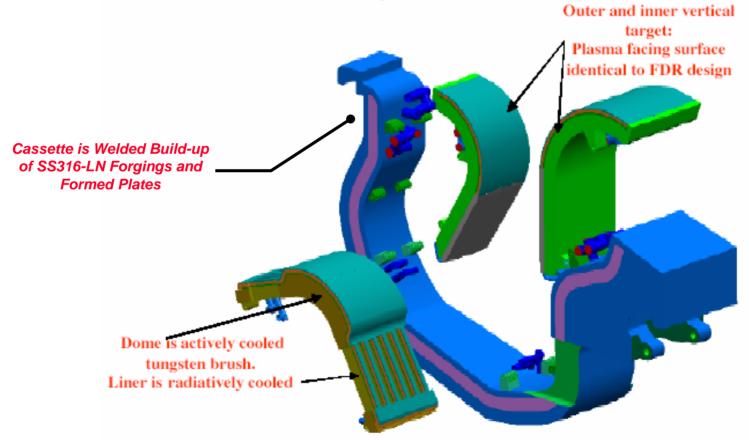
(2003 Configuration)





ITER-03 Divertor Cassette Assembly

14-Ton Assembly Including Full-Width Plasma Facing Components



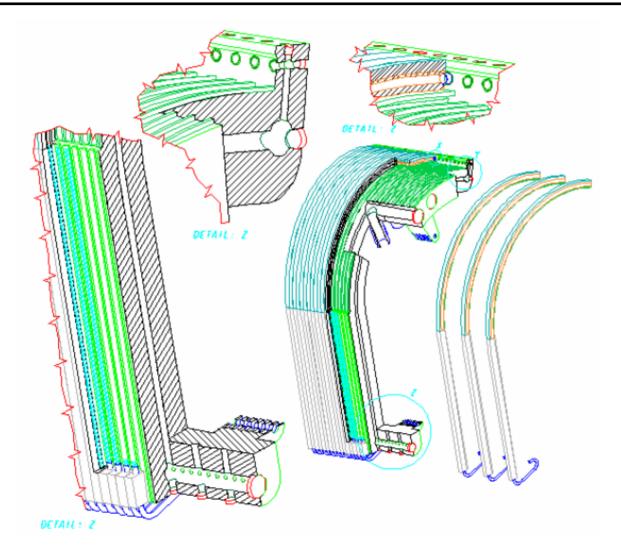


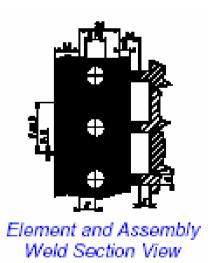
Comparison of Key Machine Parameters

Parameter	1997 Design	2003 Design
Major Radius (m)	7.8	5.5
Number Standard Cassettes	54	48
Number Diagnostic Cassettes	6	6
Number PFC's	132	60
PFC Armor Area (m²)	220	190
Cassette Size	25 Tons	14 Tons



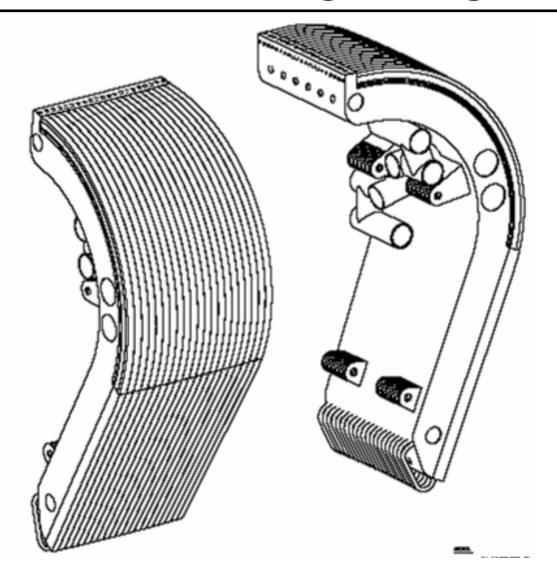
Outer Target Design





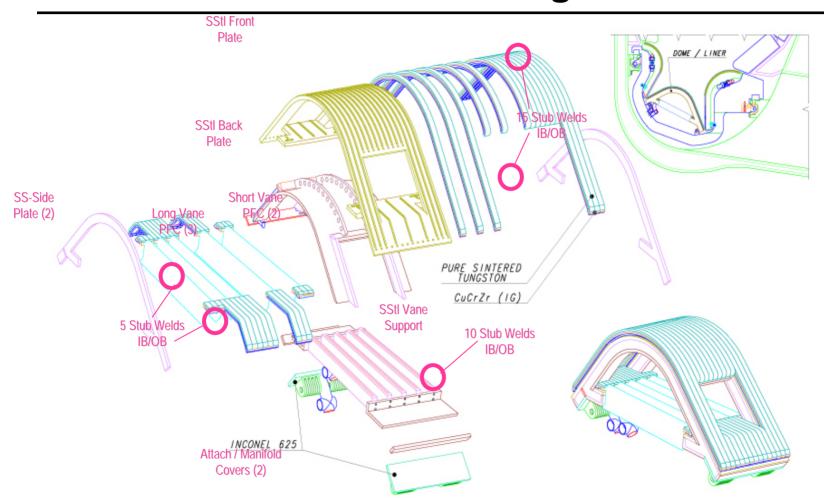


Inner Divertor Target Design



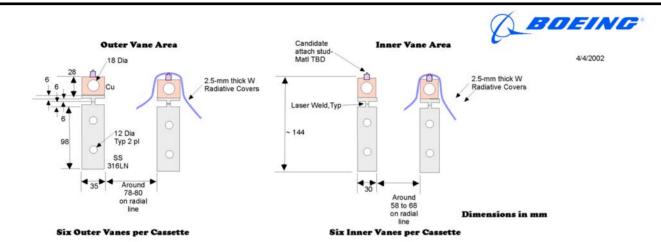


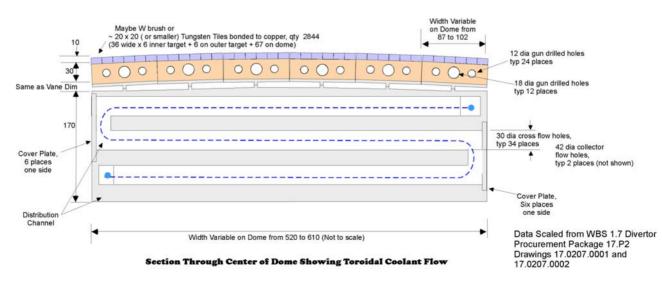
Dome PFC Design





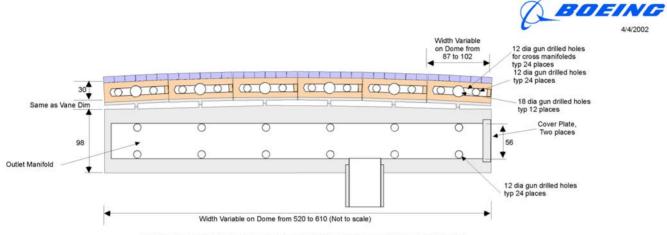
Details of Louvers under Dome



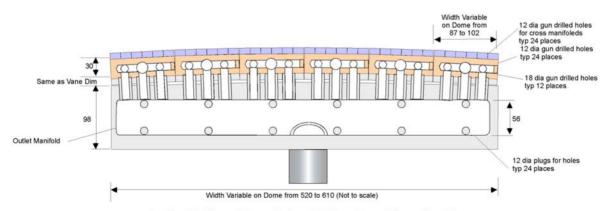




Dome PFC Detail



Section D-D Through Dome Body and PFCs at Target Illustrating Outlet

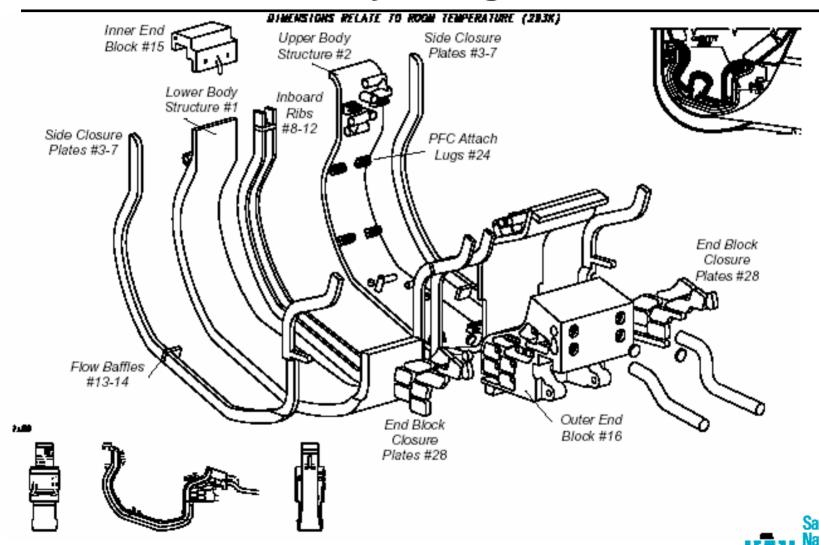


Section E-E Through Dome Body and PFCs at Target Illustrating Inlet

Data Scaled from WBS 1.7 Divertor Procurement Package 17.P2 Drawings 17.0207.0001 and 17.0207.0002

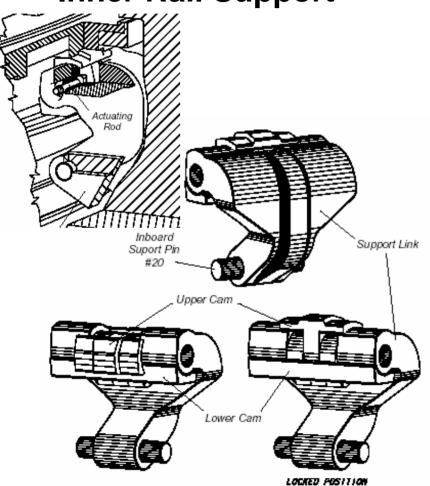


Cassette Body Design Overview

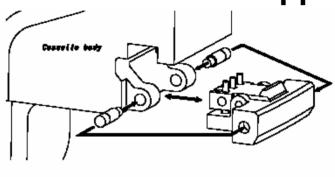


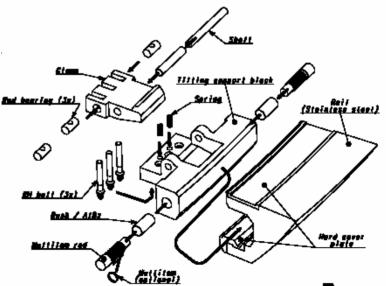
Rail Support Design Overview

Inner Rail Support



Outer Rail Support

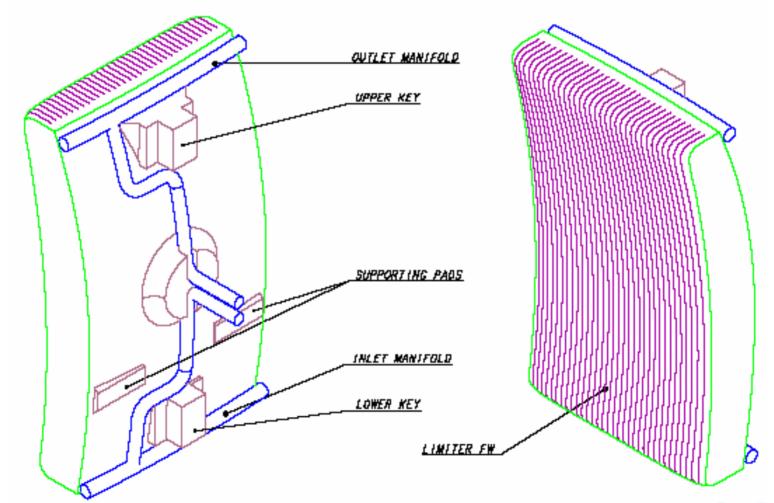




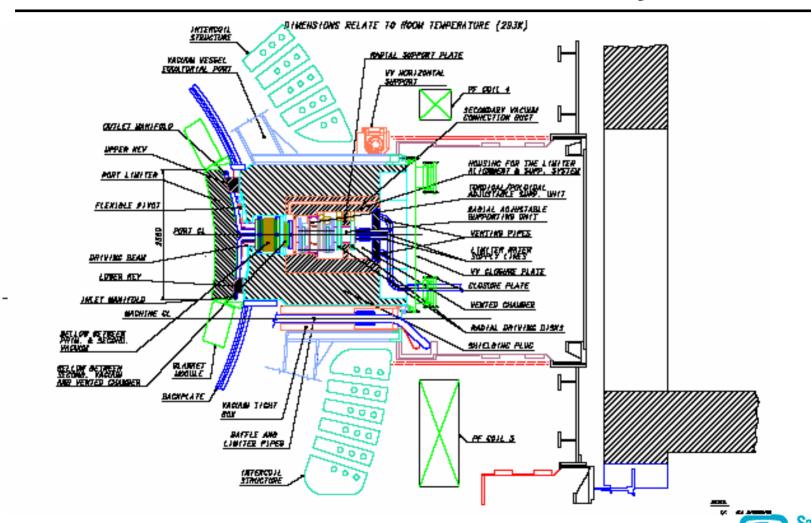
Port Limiter Design



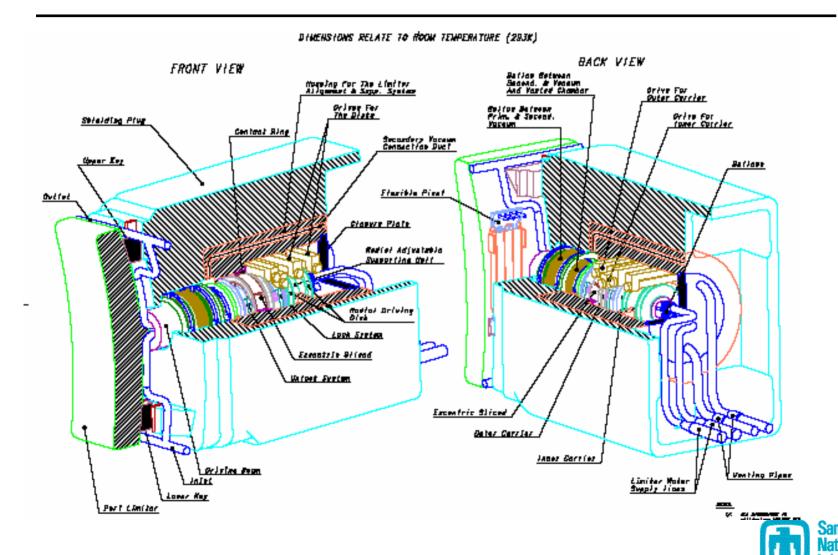
ITER Port Limiter PFC



ITER Port Limiter Assembly



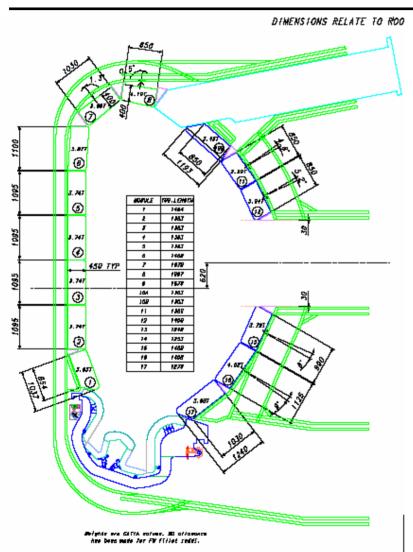
ITE Port Limiter Mechanism



Shield/First Wall Design

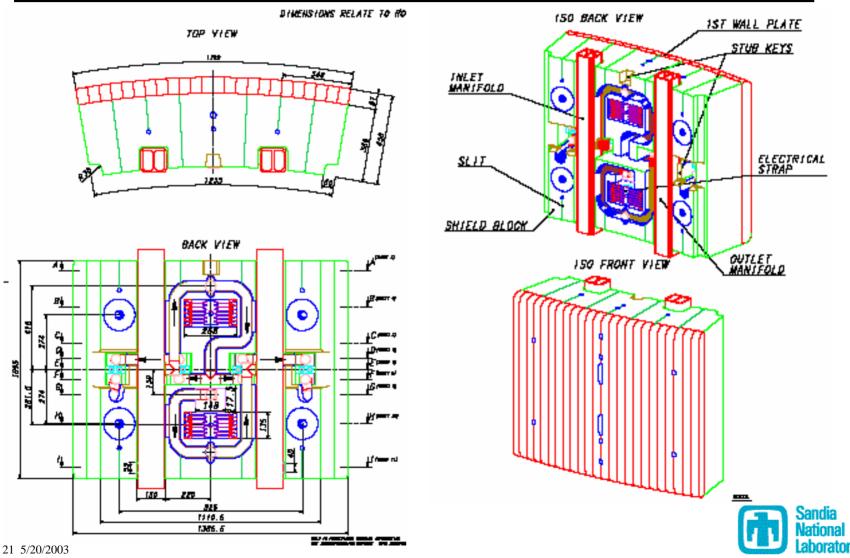


ITER FW/Shield Design

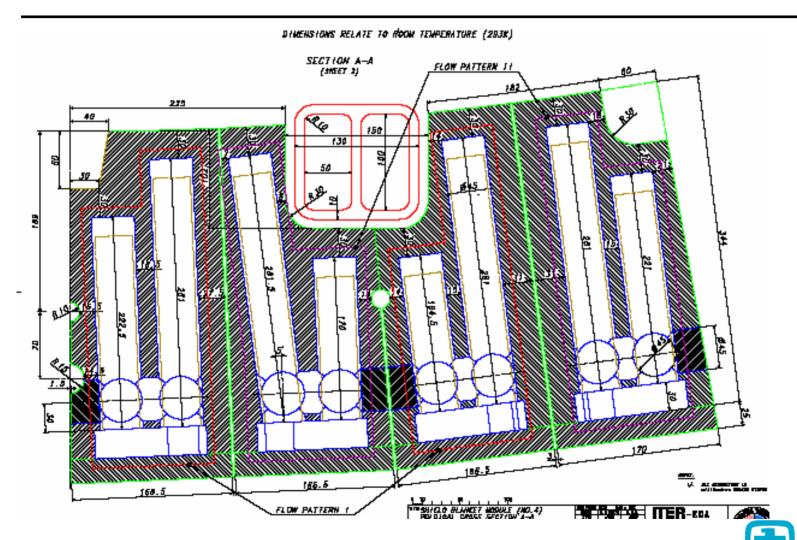




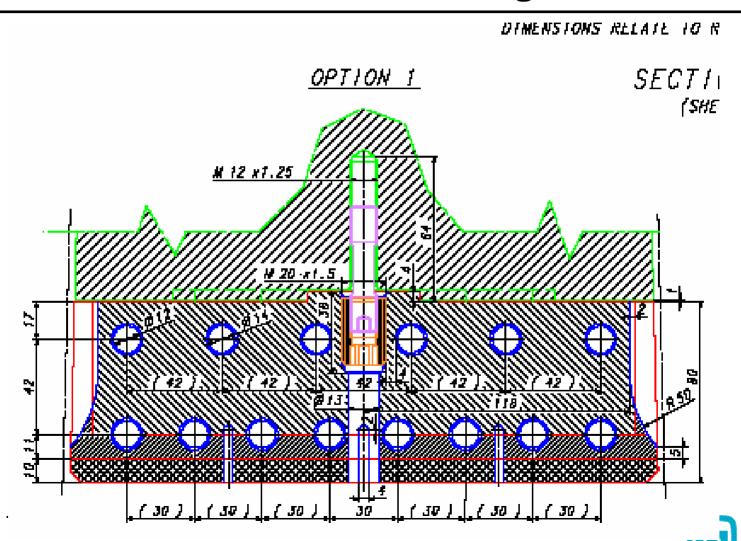
ITER Shield and FW Module



Detail of ITER Shield Module



ITER First Wall Design



Details of Proposed US Part

- Module 18 of the FW/Shield
 - 36 modules around torus
 - Shield module weight 3.6 Tonnes (316 LNIG steel)
 - PFC area 1.6m²
 - PFC weight 0.8Tonnes (Cu+316)
 - 10% of the first wall area
 - 45 cm thick (PFC +shield)



Preliminary assignment of US contribution

- The US will share FW/Shield fabrication with Korea and China (and possibly the host)
- The US has proposed to construct the "baffle module" just above the outer divertor.
- This module is identified as module 17 in the procurement package but has since been relabeled module 18
- Module 18 has a requirement for 50% spares of the PFC because the heat flux is higher and the probability of damage during a disruption is higher.



ITER interest in PMI research on near term

- Tritium retention in redeposited carbon is a major concern for ITER
- The best predictions based on data from JET and TFTR suggest the tritium inventory limit will be reached in ~150 pulses.
- Either the retention must be reduced by a factor of 100 or much more effective methods for removal (hidden areas) must be found.
- The US has been a key participant in this research and ITER wants us to continue.



ITER interest in PMI research on near term

- Convective (blob) transport in the SOL looks to have profound impact on the plasma properties near the first wall.
- The models of convective transport need to be applied to the new ITER design to determine if design changes are needed.
- ITER is interested in the joint US/EU studies on erosion and retention in mixed materials.
- There continue to be concerns about particle pumping through the divertor.



Balance Between ITER & PFC development

- Because of concerns about carbon PFCs, ITER wants to have W PFCs fully qualified for the divertor during the early part of fabrication.
- Gives them the option to change PFC material if the retention picture continues to be bleak
- Divertor fabrication is scheduled for 5 years near the end of fabrication.
- We have about 4-5 years to complete qualification of W PFCs



W PFC Development

- Long term testing of the W rod design revealed that a small percentage of the rods came loose from the Cu after thousands of cycles.
- A new option has been developed but must be tested.
- CuCrZr should be used as the heat sink since it is the preferred ITER material
- We need to conduct simultaneous normal heat flux and ELM flux testing (dual e-beam)



Balance Between ITER & PFC development

- The US is pursuing two approaches for long term PFC development
 - Liquid surfaces
 - Helium cooled refractory metal
- There is a decision point for liquid surfaces in FY07 (NSTX)
 - Key issues remain to be resolved (3 years to do)
- Other parties are not doing liquid surfaces but are doing He cooling work
 - We cannot drop He/Refractory work completely



Conclusions

- The US role on ITER PFCs is becoming clear
- Reaching ITER agreement will add new scope to PFC technology specifically directed at ITER fabrication (design and R&D)
- There are PMI issues where ITER has a strong interest in US participation
- The PFC community should discuss priorities for the near and long term and find a balance between ITER and long term needs based on those priorities.

